I. A DISCUSSION OF THE NUCLEAR μ^--CAPTURE AND PHOTO-NUCLEAR EFFECT FOR LIGHT NUCLEI BY THE INDIVIDUAL PARTICLE OSCILLATOR MODEL

II. A REMARK ON THE CONVENTIONAL PERTURBATION THEORY

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SHI SHU WU

B.S., National Tung-chi University, 1944
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I. A DISCUSSION OF THE NUCLEAR μ^--CAPTURE AND PHOTO-NUCLEAR EFFECT FOR LIGHT NUCLEI BY THE INDIVIDUAL PARTICLE OSCILLATOR MODEL

The recent photonuclear measurement of Diven and Almy[1]

(1) B. C. Diven and G. M. Almy, Phys. Rev. 80, 407 (1950)

suggests that Bohr's assumption may still be taken as the predominant interaction mechanism, even if the incident particle interacts with nuclei weakly. According to Bohr, the reaction proceeds in two stages: first, the absorption process and second, the decay of the excited quasi-stationary, intermediate nucleus resulting from the absorption process. Evidently no individual particle (I.P.) model can be expected applicable to the second stage, if nucleon emission is involved. For the evaluation of the absorption process we have made use of the oscillator I.P. model. For the nuclear μ^-- capture, we have calculated the total absorption rate R^T_{cap} and the dependence of R^T_{cap} on the energy Δc^2 absorbed by the nucleus. The curve R^T_{cap}-vs-Δc^2 has the same appearance for all the elements investigated. It shows a maximum at $\Delta c^2 = E_{peak}$. According to our calculation, the value of E_{peak} is given by $hw_o/2\pi$. Since we have made some over-simplified assumptions on the model, more appropriately we can only conclude that E_{peak} should be in the vicinity of $hw_o/2\pi$. $hw_o/2\pi$ is the distance between the I.P. levels in the oscillator potential well. For the photonuclear effect, we have calculated the integrated total absorption cross section $h/2\pi \int \sigma(w)dw$. An exact integration of the expression $\int \sigma(w)dw$ is possible on our model; however, it turns out that only dipole transitions are important. In this respect we then obtain nothing new[2].

(2) J. S. Levinger and H. A. Bethe, Phys. Rev. 78, 115 (1950)

However, in order to predict the energy dependence of $\sigma(w)$, one still has to rely on a model. Concerning this latter aspect,

we should expect different results for different models. According to our calculation, the curve $\sigma(w)$ - vs - w has the same pattern for all the light nuclei. It shows a peak at $hw/2\pi = E_{peak}$ and E_{peak} is again given by $hw_o/2\pi$. If the maximal energy E_{max} of the incident γ-ray spectrum is larger than $hw_o/2\pi$, for the integrated total absorption cross section we obtain $(h/2\pi) \int \sigma(w)\,dw = 0.03A$ Mev-barn, where A is the mass number of the nucleus. We have compared our numerical values with the experimental results. With regard to the rudimentary character of our calculation, they are in fairly good agreement with the so far known experimental evidence.

II. A REMARK ON THE CONVENTIONAL PERTURBATION THEORY

We have shown in a step-by-step way that the conventional perturbation theory can be rewritten in a new form which is then explicitly the same as Dyson's S-matrix theory.

VITA

Shi-Shu Wu was born on May 27, 1923 in Peiking, China. He graduated from the National Tung-Chi University, China, with a B.S. degree in 1944. After that he worked as a research assistant in the same University for three years. He entered the Graduate College of the University of Illinois in 1947 and received the degree of M.S. there in 1948.

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